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Effect of area specific mineral mixture and hormonal interventions on growth, blood chemistry and mineral status of the reproductive disorders cross bred cattle

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Abstract
To assess the effect of area specific mineral mixture and hormonal therapy on growth, blood chemistry and mineral status of the reproductive disorder cross-bred cattle of Kalahandi district of Odisha, 80 animals (52 cows, 28 heifers) were selected and divided into four groups of 20 animals each (containing both anoestrus and repeat breeder) in which treatment was performed for 60 days. Group I: control (farmer practice), group II: group I + area specific mineral mixture @ 50 g/animal/day, group III: group II + hormone (double synch), and group IV: group II + hormone (Estra double synch). The growth performances were measured in terms of body weight and average daily gain (ADG). Blood collection was done at the start and end of the experiment for assessment of blood biochemical and mineral status of the animals. Results revealed significant ($p< 0.05$) improvement in growth, serum glucose and mineral status of treated animals as compared to control animal.

Keywords: cattle, blood, hormones, minerals

Introduction
Minerals play a significant role in fertility by maintaining membrane integrity, and are involved in hormone production and maintenance of strong immune system. Minerals have direct or indirect relationship with productive and reproductive health of animals. Deficiencies and imbalance of minerals during peri-parturient period are solely associated with metabolic disorders like retention of fetal membranes, dystocia, abortion, weak calf syndrome and vulval discharge (Gupta *et al*., 2005) [1]. Adding mineral mixture in the ration of cross bred dairy cows for a period of 60 days recovers the animal from hypoproteinemia, hypoalbuminemia, hypocholesterolemia more efficiently than that of non-supplemented animals (Oliveira *et al*., 2014) [2] Treatment with GnRH and $PGF_{2\alpha}$ synchronises estrus, enhances ovulation and maximizes the conception rates and timed estrus behaviour in many dairy herds (Stevenson *et al.*, 2000) [3]. Therefore, an experiment was conducted on crossbred cattle to find out the effect of area specific mineral mixture (ASMM) along with hormonal intervention on their growth, blood chemistry and serum mineral profile.

Materials and methods
An on-farm trial was carried out in Kalahandi district (21° 5' North latitude and 83° 74' East longitude), which lies in South-Western part of Orissa. The average rainfall of the zone is about 1230 mm. General information like breed and age of animals, details of oestrus, treatment after oestrus, age at first calving, calving number, services per conception, date of last calving, of dairy cows were collected from the farmers. On the basis of survey, 80 reproductive disorder animals (52 cows, 28 heifers) were selected and were divided into four groups of 20 animals each (13 anoestrus and 07 repeat breeders) as per complete randomised design. The animals were dewormed with broad spectrum anthelmintic (Fenbendazole @ 10 mg/kg bodyweight) to rule out the possible effect of worms on performance of the animals. The experimental period was 60 days during which animals in control group (I) were maintained as per the traditional practices of the farmer (straw based diet with locally available concentrate) without any nutritional supplementation where as animal in II group were fed with ASMM @ 50 g per day per. The hormonal protocols like double synch and estra double synch along with ASMM @ 50 g per day per animal were tested in group III and IV respectively. In double synch protocol, PGF2α and GnRH were used twice each on any day of

cycle in the following manner (0 day: PGF2α, 2nd day: GnRH, 9th day: PGF2α, 11th day: GnRH). In Estra double synch protocol, the steps were similar to double synch protocol with replacement of the last GnRH injection with estradiol benzoate. All the treatment groups along with the control group were maintained as per the standard managemental practices.

The body weight of the cows was recorded in monthly interval during the experimental period using Johnson's formula (1940) [4]. The area specific mineral mixture was prepared as per the reported formulation of Mohapatra *et al.* (2012) [5]. Blood samples were collected at 0 and 60 days of the experiment and the concentration of glucose, total protein, albumin and urea was estimated using the kit of CREST BIOSYSTEMS (Mumbai, India). Globulin concentration was determined by subtracting the Albumin from the total protein concentration in the serum samples. The serum calcium and phosphorus concentration was estimated by using the kit prepared by CREST BIOSYSTEMS (Mumbai, India). The serum micro minerals like copper, zinc and manganese were estimated by Atomic Absorption Spectrophotometer (ELICO-SL 243, Hyderabad, India). Statistical analysis of the data obtained was done by using Software Package for Social Sciences (SPSS) Version 17.0 (2008) [6] and one-way analysis of variance (Generalized Linear Model, ANOVA) with comparison among means was made by Duncan's multiple range test (Duncan, 1955) [7] with significance level of $P \leq 0.05$.

Results and Discussion

The ingredient composition of the area specific mineral mixture is presented in Table 1. The body weight gain in the treated animals were significantly ($p < 0.05$) higher than control group whereas there was no significant ($p > 0.05$) difference observed among the three treatment groups (Table 2). This finding was in agreement with the observations of Sawant *et al.* (2013) [8] and Trenkle (1976) [9]. The increased body weight gain in ASMM supplementation might be due to increased nutrient metabolisms in supplemented animals.

The data regarding blood glucose, total protein, albumin, globulin and urea at 0 and 60 days of experiment were presented in Table 3. Among the different serum biochemical parameters only glucose concentration varied significantly ($p < 0.05$) between control and treatment groups at 60 days of the experiment. The higher blood glucose concentration in treatment groups might be due to altered molar proportion of VFA in the rumen with an increase in propionate concentration resulting in increased glucose level in the plasma due to mineral supplementation (Aliarabi and Chhabra, 2006) [10]. Similar to our observations, But Parmar *et al.* (2015) [11] reported that there was no significant difference in total protein level in oestrus-synchronized cows by different hormonal treatments.

The serum macro (Ca, P) and micro mineral concentrations were significantly ($p<0.05$) higher in treated group than control animals (Table 4). The serum concentration of calcium and phosphorus concentration at 0 days was found to be at below the critical value; Ca (9-12 mg/ml) and P (4-8 mg/ml) that may be due to the traditional feeding practices (Panda *et al.* 2014) [12]. At sixty days of the experiment both macro and micro minerals studied in the start of the experiment was varied significantly ($p<0.05$) between the control and the treatment groups. The increased serum mineral concentration might be due to extra supplementation of minerals through ASMM. Similar results were reported in dairy cattle by other workers (Agrawalla *et al.* 2017; Samanta *et al.* 2005) [13, 14].

Table 1: Composition of area specific mineral mixture

Sl. No	Ingredients	Amount/1000 g
1.	Dicalcium phosphate	800 g
2.	Wheat flour	200 g
3.	Cupric sulphate	200 mg
4.	Potassium iodide	1.63 mg
5.	Manganous sulphate	400 mg
6.	Zinc sulphate	500 mg

Table 2: Body weight changes in experimental animals: ($LG^2/660$ kg)

Attributes	Group				p value
	I	II	III	IV	
Initial BW, kg (0 day)	292.77 ±17.63	294.11 ±19.39	299.41 ±18.56	306.99 ±18.65	0.949
Final BW, kg (60 days)	300.98 ±19.66	305.09 ±21.43	310.70 ±18.61	317.64 ±21.71	0.930
Body Weight Gain (kg)	8.21^a ±0.61	10.68^b ±0.45	11.29^b ±0.47	10.65^b ±0.86	0.031
ADG (g)	136.83^a ±10.03	178.12^b ±7.47	188.16^b ±9.88	177.62^b ±14.28	0.016

Values bearing different superscripts in a row differ significantly ($p<0.05$)

Table 3: Serum biochemical profile of cross bred animals under different dietary treatments

Attributes	Group					p value
	Days	I	II	III	IV	
Glucose (mg/dl)	0	52.28 ±4.30	52.02 ±3.51	50.72 ±6.99	50.96 ±9.01	0.987
	60	46.58^a ±3.64	53.63^b ±2.84	53.20^b ±3.23	52.08^b ±2.95	0.040
Total Protein (g/dl)	0	5.39 ±0.51	5.89 ±0.67	5.75 ±0.52	5.64 ±0.26	0.929
	60	6.09 ±0.16	6.46 ±0.18	6.28 ±0.13	6.58 ±0.15	0.293
Albumin (g/dl)	0	2.43 ±0.22	2.38 ±0.23	2.51 ±0.22	2.45 ±0.27	0.984
	60	3.17 ±0.05	3.18 ±0.05	3.2 ±0.05	3.25 ±0.05	0.870
Globulin (g/dl)	0	2.96 ±0.64	3.51 ±0.85	3.24 ±0.58	3.19 ±0.42	0.941
	60	2.91 ±0.14	3.28 ±0.13	3.08 ±0.13	3.32 ±0.09	0.252
Urea (mg/dl)	0	14.34 ±1.07	15.82 ±0.73	16.99 ±0.72	13.98 ±0.88	0.080
	60	13.98 ±1.12	16.35 ±1.10	16.85 ±1.19	14.68 ±1.37	0.307

Values bearing different superscripts in a row differ significantly ($p<0.05$)

Table 4: Serum mineral profile of cross bred animals under different dietary treatments

Attributes	Group					p value
	Days	I	II	III	IV	
Ca (mg/dl)	0	6.35 ±0.56	6.05 ±0.38	6.23 ±0.43	6.34 ±0.54	0.971
	60	6.89[a] ±0.47	9.90[b] ±0.48	9.36[b] ±0.57	9.39[b] ±0.53	< 0.01
P (mg/dl)	0	3.97 ±0.41	4.18 ±0.38	4.78 ±0.35	4.98 ±0.26	0.173
	60	4.32[a] ±0.35	5.25[b] ±0.37	5.71[b] ±0.39	5.72[b] ±0.31	0.041
Zn (ppm)	0	0.74 ±0.13	0.96 ±0.14	0.74 ±0.09	0.73 ±0.13	0.801
	60	0.73[a] ±0.05	1.50[b] ±0.10	1.62[b] ±0.09	1.61[b] ±0.13	< 0.01
Cu (ppm)	0	0.77 ±0.13	0.78 ±0.14	0.74 ±0.05	0.73 ±0.09	0.894
	60	0.77 [a] ±0.04	1.43[b] ±0.06	1.42[b] ±0.06	1.39[b] ±0.05	< 0.01
Mn (ppm)	0	0.35 ±0.09	0.32 ±0.10	0.33 ±0.13	0.35 ±0.08	0.890
	60	0.35[a] ±0.03	0.64[b] ±0.04	0.65[b] ±0.04	0.57[b] ±0.05	< 0.01

Values bearing different superscripts in a row differ significantly ($p<0.05$)

Conclusion

Supplementation of area specific mineral mixture along with hormonal intervention (double synch and estra double synch) enhanced the growth and serum mineral concentration in repeat breeding and anoestrus animal.

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